IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Levy
Application No: 10/774,312
Filed: February 5,2004
For: WATERMARKING SYSTEMS AND METHODS
Examiner: K. Fujita
Date: July 22, 2009

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APPEAL BRIEF
(Second)

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Sir:

This Appeal Brief is responsive to the *Notice of Appeal* filed April 22, 2009.

We ask that Appellant's previously paid Appeal Brief fee ($540, paid November 4, 2008) be applied to this Brief, since prosecution was reopened by the Examiner after the filing of Appellant's previous Brief.

The Office is authorized to charge our Deposit Account No 50-1071 for any additional fees which may be required in connection with filing of this Appeal Brief.

I. REAL PARTY IN INTEREST

The real party in interest is Digimarc Corporation of Beaverton, Oregon.

II. RELATED APPEALS AND INTERFERENCES

None.

(Appellant earlier filed a *Notice of Appeal*, and *Appeal Brief*, in this application, but prosecution was then re-opened and the Office issued a new Action. This Appeal is taken from that Action.)

III. STATUS OF CLAIMS

Claims 1-6 and 8 are rejected and appealed.

IV. STATUS OF AMENDMENTS

All prior amendments have been entered.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The claimed technology relates to steganographic digital watermark technology. In one particular aspect it concerns arrangements for making certain digital watermark signals resistant to attack. In another particular aspect it concerns arrangements for decoding watermark signals without the need to perform a certain log-polar remapping operation.

Steganographic digital watermarking is the science of encoding plural-bit data (e.g., a message) in a content object (e.g., an image or video), in such a manner that the data is essentially hidden from human perception, yet can be recovered by computer analysis.[1]

One problem that arises in many watermarking contexts is that of object corruption. If the object is reproduced, or distorted, in some manner such that the content presented for watermark decoding is not identical to the object as originally watermarked, then the decoding process may be unable to recognize the embedded watermark. To deal with such problems, the watermark can convey a reference signal. The reference signal is of such a character as to permit its detection even in the presence of relatively severe distortion. Once found, the attributes of the distorted reference signal can be used to quantify the content's distortion. Watermark decoding can then proceed – informed by information about the particular distortion present.[2]

The assignee's patents 6,408,082 and 6,614,914 detail certain reference signals or features that are added to the watermark, permitting watermark decoding even in the presence of distortion. In some image watermarking embodiments, the reference features (collectively the "template") comprise a constellation of quasi-impulse functions in the Fourier magnitude domain, each with pseudorandom phase. To detect and quantify the

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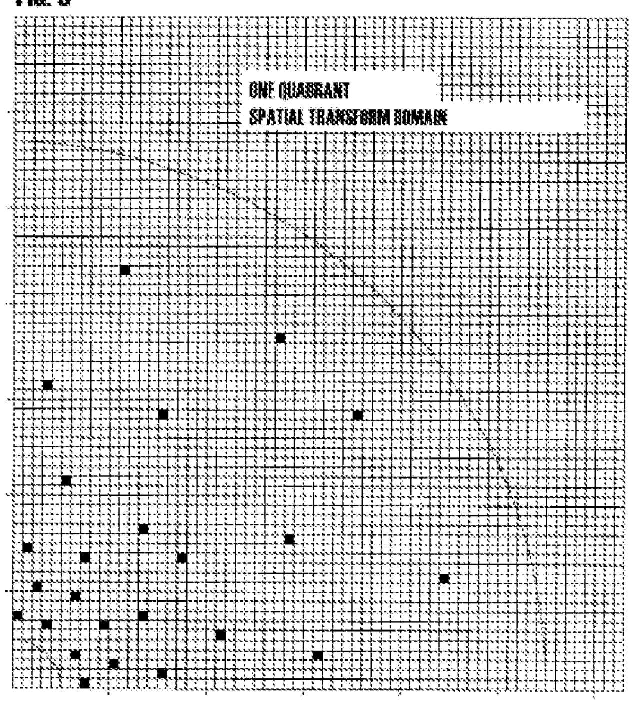
[1] Specification, page 1, lines 12-14.

distortion, the watermark decoder converts the watermarked image to the Fourier magnitude domain and then performs a log polar resampling of the Fourier magnitude image. A generalized matched filter correlates the known reference features with the re-sampled watermarked signal to find the rotation and scale parameters providing the highest correlation. The watermark decoder performs additional correlation operations between the phase information of the known reference features and the watermarked signal to determine translation parameters, which identify the origin of the watermark message signal. Having determined the rotation, scale and translation of the watermark signal, the watermark reader can, e.g., adjust the image data to compensate for these distortions, and then proceed to extract the watermark message signal.[3]

A representative template signal is illustrated in incorporated-by-reference patent 6,408,082,[4] by its frequency domain representation, as follows:

FIG. 3



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2 Specification, page 2, lines 13-21.

3 Specification, page 2, line 22 – page 3, line 6.

4 Specification, page 3, line 16; page 11, lines 13-15.

Sometimes an attacker wishes to prevent successful decoding of the watermark, e.g., where the watermark is used in an anti-piracy application. One attack is to average several different watermarked content objects (e.g., images). When averaged, the content itself becomes uncorrelated noise. But the constellation of reference features (quasi-impulse functions in the Fourier magnitude domain, as shown above), which are common across all watermarked images, tend to reinforce each other through such averaging operation, making it possible to identify these reference features and target them for removal.[5]

Independent claim 1 is a Jepson claim directed to methods for making these reference features resistant to attack. In the preamble the claim recites encoding one or more content objects with a steganographic digital watermark – including embedding a collection of features that can be used to facilitate computation of geometrical distortion (including rotation) of the object after encoding.[6]

The "improvement" of the Jepson claim is phrased as a § 112, ¶ 6 "step plus function," namely, a "step for making the collection of features resistant to attack."

There are several "acts" detailed in the specification corresponding to this "step." For example, page 3, lines 21-22, explains that instead of simply adding the constellation of reference features to watermarked content, the constellation can be added to some content, and subtracted from other content. If such content is averaged together, the reference features no longer reinforce; rather, they cancel. (The preferred decoder, detailed in incorporated-by-reference patents 6,408,082 and 6,614,914,[7] is indifferent to whether the reference features are added or subtracted.)

A second act in support of the claimed "step plus function" is detailed at page 3, lines 23-25. Instead of adding the same constellation of reference features to all content,

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5 Specification, page 3, lines 14-19.
6 Specification, page 2, line 13 – page 3, line 6.
7 Specification, page 2, line 22; page 11, lines 13-15.

the template is varied between images. For example, it can be rotated differently in different images. Or its phase can be shifted differently in different images. (The preferred decoder can decode the watermark correctly despite such operations.) Again, such acts cause the reference features not to reinforce when content is averaged.

A third act in support of the claimed “step plus function” is detailed at page 3, lines 29-30. In this arrangement, the template is scaled slightly differently in different images – again, preventing it from becoming evident when several watermarked images are summed. (The preferred decoder is robust to scaling.)

While averaging several different content objects to discern a common watermark is one form of attack, another attack involves just a single content object – in which the watermark has been encoded repeatedly.[8] Again, different portions of the single watermarked object can be averaged together to discern the common watermark.

To redress this attack, a fourth act in support of the claimed “step plus function” of claim 1 is detailed at page 4, lines 3-5. In this arrangement, the reference features do not manifest themselves in the Fourier magnitude domain, but rather in an alternate domain to which an attacker may not turn. A fifth act is related: the template may be keyed, using an invariant keying method that doesn’t require additional search over different scale and rotation values to locate.[9]

Independent claim 6 is a Jepson claim directed to methods for decoding, from an encoded object, a steganographic digital watermark that includes a template signal for aiding in determining corruption of the object (such as rotation).[10]

Again, the “improvement” of the Jepson claim is phrased as a § 112, ¶ 6 “step plus function.” In this claim it is “step for detecting the template signal without log-polar remapping.”

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8 Specification, page 4, lines 1-3.
9 Specification, page 4, lines 5-7.
10 Specification, page 2, line 13 – page 3, line 6; page 3, lines 14-16.

Again, the specification details “acts” corresponding to this “step.” For example, page 4, lines 16-27 explains:

> Related methodology helps perform preliminary detection of a template signal in the Fourier domain. It has three stages. First, find local maxima on half of the Fourier magnitude array. Then use the 90-degree rotation symmetry of the template to eliminate most of the local maxima in a quadruple, where in this stage certain tolerance is added. Third, check each pair of the left maxima in the quadruple to see if the angle between them and the ratio of their radial distances to the origin make them a pair of points on our template or not. If they are, what scale factor and orientation angle of the template in this case. After running through the total of about 50 maxima (for 128 x 128 block), accumulated count on a particular orientation and scale factor will indicate what the orientation and scale factor of the gird is when there is a template signal. A threshold is used to judge if there is a template signal or not. (This methodology avoids log-polar re-mapping, as is required by some other approaches.)

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claims 1, 5, 6 and 8 are rejected as anticipated by Hayashi (US 20010055390).

Claim 2 is rejected as obvious over Hayashi in view of Liao (6,654,479).

Claim 3 is rejected as obvious over Hayashi in view of Cos (5,930,369).

Claim 4 is rejected as obvious over Hayashi in view of Jones (6,792,130).

VII. ARGUMENT

1. Hayashi (US 20010055390)

Like the present technology Hayashi concerns digital watermarking, in which a watermark includes registration signals allowing geometric transformations of the encoded host signal to be identified - permitting recovery of the watermark notwithstanding such transformations. However, Hayashi does not teach how these registration signals may be made resistant to attack.

2. Claim 1 (§102 Hayashi)

Claim 1 reads as follows:

> *1. In a method that includes encoding one or more content objects with a steganographic digital watermark, the encoding including embedding a collection of features that can be used to facilitate computation of geometrical distortion of the object after encoding, the geometric distortion including rotation, an improvement including <u>step for making the collection of features resistant to attack</u>.*

(Emphasis added.)

The rejection fails for two reasons.

First, Hayashi does not teach a method for making his collection of features (termed registration signals) <u>resistant to attack</u>. The Office cites paragraph [0005] for such teaching.[11] However, this paragraph simply introduces the concept of an added signal (which he terms the registration signal) that is used to determine geometric distortion to which an encoded image has been subjected.

This teaching corresponds to the *preamble* of claim 1 – not the *improvement* clause, as asserted by the Office.

In *Response to Arguments*, the Office contends that Hasyashi's ability to decode a watermark despite geometric distortion, meets the "resistant to attack" limitation. However, such interpretation – equating the geometric distortion with the claimed "attack" – essentially reads the "improvement" out of Appellant's claim.

The term "attack" should be construed in a manner that gives effect to the "improvement" clause of the claim. The specification provides guidance in interpreting "attack" – under the heading *Template-Based Watermark Attacks and Countermeasures* beginning on page 3.

The attack particularly considered is the so-called "averaging" or "collusion" attack (e.g., at page 3, lines 13-20), in which several differently-watermarked signals are

[11] Final Rejection, page 4, line 8.

averaged. In this scenario, the different host signals (e.g., images) are uncorrelated noise, whereas the watermark template is consistent across all images, and thus persists through averaging. Once so-identified, an attacker can eliminate it, e.g., by subtraction.

Construed with reference to the specification, an artisan would understand that "attack" is not meant to cover routine signal processing operations such as image rotation or cropping. Instead, "attack" refers to a procedure performed to interfere with the watermark's normal operation.

It is improper for the Office to interpret the claim in a manner that essentially "reads-out" the improvement clause from the claim. Accordingly, the rejection should be reversed.

Additionally, the rejection fails because the Office has not applied the *Donaldson* analysis required when examining a claim phrased in step-plus-function format. See *In re Donaldson*, 16 F.3d 1189, 29 USPQ2d 1845 (Fed Cir, 1994). *See also: Examination Guidelines For Claims Reciting A Means or Step Plus Function Limitation In Accordance With 35 U.S.C. 112, 6th Paragraph,* 1162 O.G. 59 (May 17, 1994).

Because the Office improperly construed claim 1 so as to render the "improvement" clause meaningless, and failed to apply the proper analysis under § 112, ¶ 6, the rejection of claim 1 should be reversed.

3. <u>Claim 5 (§102 Hayashi)</u>

Claim 5 is patentable for its dependence on claim 1, and is also separately patentable. The claim reads:

> *5. The method of claim 1 wherein said step includes obscuring said collection of features by designing same to become apparent only in an alternate domain.*

The Office cites Hayashi at Fig. 4, item 402 as anticipatory. However, item 402 shows a Fourier transforming unit.

Construed with reference to the specification, "*obscuring said collection of features by designing same to become apparent only in an alternate domain*" means that the features are not in the domain where they would be evident, i.e., not in the Fourier domain taught by the prior art. (See the discussion of prior art at page 2, lines 24-25, of the present specification.)

The cited teaching of Hayashi draws from the prior art cited in Appellant's specification. Presentation of Hayashi's registration signals in the Fourier domain would not be "obscured" – they would be where the prior art teaches they will be found.

The anticipation rejection of dependent claim 5 should thus be reversed.

4. <u>Claim 6 (§102 Hayashi)</u>

Claim 6 reads as follows:

> *6. In a method that includes decoding a steganographic digital watermark from an encoded object, the encoding including a template signal that aids in determining corruption of the object, the corruption including rotation, an improvement comprising <u>step for detecting the template signal without log-polar remapping</u>.*

(Emphasis added.)

The rejection falls for two reasons.

First, Hayashi does not teach the claimed arrangement. This was conceded by the Office earlier during prosecution, when it allowed claim 6 (but rejected all other claims over Hayashi – alone or in combination with other art).

In particular, at the top of page 9 of the Action mailed May 2, 2008, the present Examiner stated that the prior art does not teach the specific method steps of detecting the template signal without log-polar remapping, per 35 USC 112 sixth paragraph. The Examiner quoted the specific acts from the specification to which the claimed "step" corresponds – acts missing from the prior art of record:

> stated in claim 6 that are invoked by 35 U.S.C. 112 sixth paragraph, indicated in Applicant's remarks on page labeled 6. The specific steps not taught by the prior art are as follows:
>
> > "First, find local maxima on half of the Fourier magnitude array. Then use the 90-degree rotation symmetry of the template to eliminate most of the local maxima in a quadruple, where in this stage certain tolerance is added. Third, check each pair of the left maxima in the quadruple to see if the angle between them and the ratio of their radial distances to the origin make them a pair of points on our template or not. If they are, what scale factor and orientation angle of the template in this case. After running through the total of about 50 maxima (for 128 x 128 block), accumulated count on a particular orientation and scale factor will indicate what orientation and scale factor will indicate what the orientation and scale factor of the gird is when there is a template signal. A threshold is used to judge if there is a template signal or not." (found in the specification on page 4).

Those acts are still missing from the prior art.

The second reason for reversal is related: the Office has again failed to apply the required *Donaldson* criteria.

Again, the rejection should be reversed.

5. Claim 8 (§102 Hayashi)

The rejection of dependent claim 8 stands or falls with the rejection of claim 1, from which it depends.

6. Claim 2 (§103 Hayashi + Liao)

Claim 2 is allowable for its dependence from claim 1, and is also independently allowable. The claim reads as follows:

> *2. The method of claim 1 wherein said step includes adding said collection of features in some of said objects, and subtracting said collection of features from other of said objects.*

Recall that the "collection of features" required by the claim serves to facilitate computation of geometrical distortion – <u>including rotation</u> – of the object after encoding (per claim 1).

Liao is silent about rotation. The Office apparently believes Liao employs a collection of features that can be used to facilitate computation of rotation. However, no evidence in support of such assertion is offered.

Moreover, the Action also neglects the "object<u>**s**</u>" limitation of claim 2.

The claim is drawn to a method in which *plural* objects are encoded. To some, the claimed "collection of features" (*c.f.*, relevant to rotation) is added. To others, the claimed collection is subtracted.

Liao, in contrast, teaches adding and subtracting within a *single* image. See elements 214 and 218 in Fig. 2A.

Liao does not teach a method of encoding content object<u>**s**</u> in the manner claimed.

If plural images were watermark-encoded by Liao, they would *all* be processed identically – not in two different manners as claimed.

Since Liao does not teach that for which it has been cited, the Office has not met its burden of establishing obviousness. Reversal is required.

7. <u>Claim 3 (§103 Hayashi & Cox)</u>

Claim 3 is allowable for its dependence from claim 1, and is also independently patentable. The claim reads:

> *3. The method of claim 1 wherein said step includes embedding said collection of features at a first scale in a first object, and embedding said collection of features at a second, different scale in a second object.*

The Office cites Cox at col. 10, line 20, for teaching multiple scaling factors. Again, it appears the Office has misapprehended the claim and/or the art.

Like just-discussed claim 2, claim 3 requires embedding the claimed collection of features into *plural* objects. The embedding is performed differently in the first object than in the second object.

Cox does not teach this.

Cox varies the values of image pixels by a slight amount to encode a watermark. In particular, equations (1) – (3) set forth in columns 9-10 detail how his original pixel values (x_i) are varied.

The magnitude of the variation needn't be constant for all pixels in an image. As Cox explains (col. 10, lines 6-8):

> *[I]f $x_i = 10^6$ then adding 100 may be insufficient to establish a watermark, but if $x_i = 10$, then adding 100 will unacceptably distort the value.*

Thus, Cox suggests scaling the amount of pixel variation, in accordance with the value of pixel being changed (e.g., larger changes to larger-valued pixels, etc.).

Claim 3, in contrast, requires "embedding said collection of features <u>at a first scale in a first object</u>, and embedding said collection of features <u>at a second, different scale in a second object</u>." Cox does not teach this.

Again, because the art fails to teach that for which it has been cited, the Office's burden of establishing obviousness has not been met.

8. <u>Claim 4 (§103 Hayashi + Jones)</u>

The rejection of claim 4 stands or falls with the rejection of claim 1, from which it depends.

VIII. <u>CONCLUSION</u>

The § 102 rejections fail in view of factual mis-understanding of the prior art teachings, and legal error in the applied analysis. The § 103 rejections are similarly flawed. Accordingly, the Board is requested to reverse the rejections of claims 1-6 and 8.

Respectfully submitted,

Date: July 22, 2009

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CLAIMS APPENDIX

1. In a method that includes encoding one or more content objects with a steganographic digital watermark, the encoding including embedding a collection of features that can be used to facilitate computation of geometrical distortion of the object after encoding, the geometric distortion including rotation, an improvement including step for making the collection of features resistant to attack.

2. The method of claim 1 wherein said step includes adding said collection of features in some of said objects, and subtracting said collection of features from other of said objects.

3. The method of claim 1 wherein said step includes embedding said collection of features at a first scale in a first object, and embedding said collection of features at a second, different scale in a second object.

4. The method of claim 1 wherein said step includes embedding said collection of features at a first orientation in a first object, and embedding said collection of features at a second, different orientation in a second object.

5. The method of claim 1 wherein said step includes obscuring said collection of features by designing same to become apparent only in an alternate domain.

6. In a method that includes decoding a steganographic digital watermark from an encoded object, the encoding including a template signal that aids in determining corruption of the object, the corruption including rotation, an improvement comprising step for detecting the template signal without log-polar remapping.

7. (Canceled)

8. An object produced by the process of claim 1.

9. (Canceled)

IX. EVIDENCE APPENDIX

None

X. <u>RELATED PROCEEDINGS APPENDIX</u>

None